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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04L 12/56, 12/28, H04M 7/00 — A1

(11) International Publication Number: WO 00/35153

(43) International Publication Date: 15 June 2000 (15.06.00)

(21) International Application Number: PCT/US99/27400

(22) International Filing Date: 19 November 1999 (19.11.99)

(30) Priority Data:

| | | |
|---|---|---|
| 60/110,972 | 4 December 1998 (04.12.98) | US |
| 09/415,907 | 8 October 1999 (08.10.99) | US |

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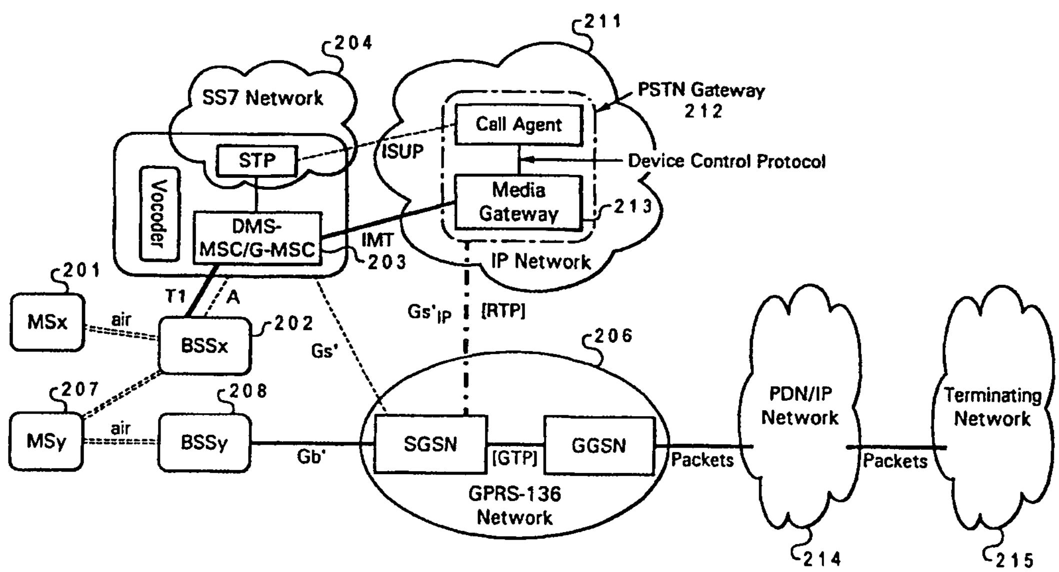
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published**

*With international search report.*
*Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: SYSTEM AND METHOD FOR IMPLEMENTING XoIP OVER ANSI-136-A CIRCUIT-SWITCHED/PACKET-SWITCHED MOBILE COMMUNICATIONS NETWORKS




(57) Abstract

The SS7 interface of a conventional GPRS-136 or GPRS-136HS network is replaced with an IP interface. An IP interface is placed between the ANSI TIA/EIA-41 circuit-switched network and the GPRS-136 packet-switched network. This interface can handle both signaling and bearer traffic and thereby overcomes the limitations imposed by the current SS7 interface, which can handle only signaling.

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# SYSTEM AND METHOD FOR IMPLEMENTING XoIP OVER ANSI-136-A CIRCUIT-SWITCHED/PACKET-SWITCHED MOBILE COMMUNICATIONS NETWORKS

## Description

### Technical Field

The present invention generally relates to improved mobile telecommunications systems and in particular to improved packet-switched wireless/wired communication systems. Still more particularly, the present invention relates to an improved packet-switched telecommunications system which utilizes Internet Protocol packet communications.

### Background Art

The written description utilizes a large number of acronyms to refer to components, methods and services. Although these acronyms, and the corresponding protocols and technologies, are known to those of skill in the art, for purposes of this discussion and convenience for the reader, acronyms will be defined as follows:

| | |
|---|---|
| AMPS | Advanced Mobile Phone Service. TIA analog cellular, and all standards that retain compatibility with it (NAMPS, D-AMPS, CDMA) |
| ANSI | American National Standards Institute. |
| BSS | Base Station System |
| DCCH | Digital Control Channel. The control channel used by IS-136 and TIA/EIA-136 D-AMPS systems. |
| DTC | Digital Traffic Channel |
| DMS | Digital Multiplex Switch |
| EIA | Electronics Industry Association |
| Gateway MSC | An MSC designed to provide a gateway between a TIA/EIA-136 / ANSI-41 network and a GPRS-136 network. |

| | |
|---|---|
| GGSN | Gateway GPRS Support Node |
| GPRS | Generalized Packet Radio Service. A GSM-based packet data protocol. |
| GSM | Global System for Mobile Communications. |
| GTP | GPRS Tunnelling Protocol |
| IMT | International Mobile Telecommunications |
| ISUP | ISDN User Part. SS7 signaling between switches. |
| MDIS | Mobile Data Interface System |
| MGCP | Media Gateway Control Protocol |
| MSC | Mobile Switching Center |
| MSC-G | Gateway MSC. |
| MSC-H | Home MSC. |
| MSC-O | Originating MSC. |
| MSC-V | Visited MSC. The MSC in which a mobile is currently registered. |
| PDN | Public Data Network |
| POTS | Plain Old Telephone Service |
| PSTN | Public Switched Telephone Network |
| Protocol | A specification of the messages used to communicate over one or more interfaces. |
| RTP | Real-Time Transport Protocol |
| SCP | Signal Control Point |
| SGSN | Serving GPRS Support Node |
| STP | Signal Transfer Point |
| SS7 | Signaling System Number 7 |
| TDMA | Time Division Multiple Access. A modulation technique used, *e.g.*, by GSM. |
| TIA | Telecommunications Industry Association |
| TIA/EIA-136 | TDMA air interface standard. Replaces IS-136. |
| XoIP | Communications via Internet Protocol, where X can represent voice, data, video, etc. |

In the current version of the ANSI TIA/EIA-136 and ANSI TIA/EIA-41 standards, the Digital Control Channel (DCCH) and Digital Traffic Channel (DTC) support speech, asynchronous circuit-switched data, and G3 Fax services.

All three of these services are circuit-switched oriented. Revisions are now being made to the ANSI TIA/EIA-136 standard to produce ANSI TIA/EIA-136-A and ANSI TIA/EIA-136-B. ANSI TIA/EIA-136-A will specify a packet-switched data service known as "136+"or GPRS-136. ANSI TIA/EIA-136-B will specify a high-speed packet-switched service known as "136HS" or GPRS-136HS. The core technology for both of these packet-switched services is based on GPRS and EGPRS, respectively. These are ETSI GSM standards.

**Figure 1** shows a conventional GPRS-136-based network where voice and circuit-switched data is still supported by the circuit switched network **103/104** but packet-switched data is supported by the GPRS-136 packet data network **106**. Gateway MSC (G-MSC) **103** is a new functional entity standardized for GPRS-136, which is an MSC having the capability to provide a gateway to GPRS-136 network. Hence, G-MSC can be viewed as a part of MSC or a separate network Node. If it is considered a separate node, the SS7 'E' interface is used to exchange signaling messages with MSC.

In **Figure 1**, a mobile station MSx **101**, which incorporates a vocoder and handles voice or circuit-switched data calls, communicates over the air with a BSSx switch **102**, which supports voice and/or circuit switched data. The BSSx **102** communicates via both a T1 bearer traffic interface and a signaling interface A with a gateway mobile switching center **103**. The SS7 network **104** is connected, in turn, with a terminating network **105** and a GPRS-136 network **106**. Note that connection **Gs'**, between the SS7 network **104** and the GPRS-136 network **106**, is a signaling interface only.

A GPRS-136 mobile station MSy **107**, also incorporating a vocoder and configured to support voice and/or packet-switched data, communicates over the air with a BSSy switch **108**, which supports packet data. The BSSy **108** communicates over a bearer traffic interface **Gb'** with the GPRS-136 network **106**. For voice calls, the vocoder of MSy **107** communicates with the BSSx switch **102**, as described above.

GPRS-136 network **106** is connected to Public Data Network (PDN) **109**. The PDN includes any destination terminal equipment **110**.

TDMA service operators have expressed a desire to implement XoIP over the GPRS-136 network (where X can represent voice, data, video, etc., *e.g.*, VoIP). XoIP can be implemented over the circuit-switched or packet-switched air interface. However, the current interface Gs' to the GPRS-136 packet-switched network is standardized for signaling only and is implemented via SS7. Therefore, if the circuit-switched air interface is to be used, this is a problem, because XoIP involves the transmission of both signaling and bearer traffic. Therefore, the SS7 interface is inappropriate and an XoIP solution utilizing the GPRS-136 network would be greatly desired.

## Disclosure of Invention

It is therefore one object of the present invention to provide an improved mobile telecommunications system.

It is another object of the present invention to provide an improved packet-switched mobile telecommunications system.

It is yet another object of the present invention to provide an improved packet-switched telecommunications system which utilizes Internet Protocol packet communications.

The foregoing objects are achieved as is now described. According to the preferred embodiment of the invention, the SS7 interface of a conventional GPRS-136 network is replaced with an IP interface. In this embodiment. an IP interface is placed in parallel with the Gs' interface between the DMS MSC/G-MSC and the GPRS-136 packet-switched network. This interface can handle both signaling and bearer traffic and thereby overcomes the limitations imposed by the current SS7 interface, which can handle only signaling.

The above as well as additional objectives, features, and advantages of the present invention will become apparent in the following detailed written description.

## Brief Description of Drawings

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with August 18, 1999the accompanying drawings, wherein:

**Figure 1** depicts a conventional GPRS network;

**Figure 2** is an improved GPRS/IP network, in accordance with a preferred embodiment of the invention;

**Figure 3** shows a diagram of the delivery of a telephone call or circuit-switched data transaction originating in an ANSI-136-A voice or circuit-switched data mobile station to an IP network, in accordance with a preferred embodiment of the invention;

**Figure 4** shows a diagram of the delivery of a telephone call or circuit-switched data transaction originating in an ANSI-136-A voice or circuit-switched data mobile

station to another ANSI-136/ANSI-41 network (or vice versa) via an IP network, in accordance with a preferred embodiment of the invention; and

**Figure 5** shows a diagram of the delivery of a telephone call or circuit-switched data transaction originating in an ANSI-136-A voice or circuit-switched data mobile station to a Circuit-Switched Network (SCN) such as PSTN, ISDN via an IP network, in accordance with a preferred embodiment of the invention.

Best Mode for Carrying Out the Invention

With reference now to the figures, and in particular with reference to **Figure 2**, according to the preferred embodiment, the GS' interface of the conventional GPRS-136 network is improved to support bearer data and call control signaling in addition to existing signaling. The improved GS' interface also replaces transport of this interface from SS7 with IP. Further, the preferred embodiment bypasses the vocoder which currently is required by the G-MSC/MSC. It should be noted that where "GPRS-136" is used below, it is intended to apply to the entire GPRS-136 "family", including GPRS, EGPRS, GPRS-136, and GPRS-136HS. Further, those of skill in the art will recognize that the innovative system and techniques described below will also apply to other wireless standards and technologies.

The preferred embodiment is thus a great improvement over the conventional GPRS-136 network shown in **Figure 1**, in which the current interface (Gs') between the Gateway MSC (G-MSC) and SGSN node of packet data network is standardized for signaling only and is implemented via SS7.

As shown in **Figure 2**, a new functional node, also known as PSTN gateway **212**, is defined between the traditional network and the IP network **211**. Different interfaces of the PSTN gateway are currently being standardized in IETF (Internet Engineering Task Force), and specific implementations are within the ability of one of ordinary skill in the art. A standard device control protocol can be used between its three functional entities, the Media Gateway, (MG) the Media Gateway Controller

(MGC), and Call Agent (CA) or Signaling Gateway (SG). In all figures, CA is assumed to support the functionality of MGC.

According to the preferred embodiment, there is no change in the way voice is handled, from an access point of view, i.e., there are no changes required at BSS or Mobile. Signaling for a voice call is still handled by A interface and bearer is transported using T1 links.

With reference to **Figure 2**, voice and circuit-switched data is still supported by the circuit switched network **203/204** and packet-switched data is supported by the GPRS-136 packet data network **206**. Gateway MSC (G-MSC) **203** provides a gateway to GPRS-136 network.

In **Figure 2**, a mobile station MSx **201**, which can incorporate a vocoder and handles voice or circuit-switched data calls, communicates over the air with a BSSx switch **202**, which supports voice and/or circuit switched data. The BSSx **202** communicates via both a T1 bearer traffic interface and a signaling interface A with a gateway mobile switching center **203**. The SS7 network **204** is connected, in turn, with a GPRS-136 network **206**. Note that connection **Gs'**, between the SS7 network **204** and the GPRS-136 network **206**, is a signaling interface only.

A GPRS-136 mobile station MSy **207**, also incorporating a vocoder and configured to support voice and/or packet-switched data, communicates over the air with a BSSy switch **208**, which supports packet data. The BSSy **208** communicates over a bearer traffic interface **Gb'** with the GPRS-136 network **206**. For voice calls, the vocoder of MSy **207** communicates with the BSSx switch **202**, as described above.

GPRS-136 network **206** is connected to PDN/IP network **214**. The PDN/IP network **214** is connected to terminating network **215**.

According to the preferred embodiment, for outgoing calls, the signaling data is sent to Call Agent **212** from SS7 network **204** and bearer data is sent to MG **213** from DMS MSC/G-MSC **203**. The MG **213** of this gateway converts media (voice etc.) appropriately. These media packets are sent to SGSN of GPRS-136 network **206** via **Gs'ip** interface. Within the GPRS-136 network **206,** packets are passed to GGSN, and then the packets are passed to PDN/IP network **214** and terminating network **215**, as it has been done for data packets in conventional systems.

For incoming calls, all packets are received by the GGSN from the PDN/IP network **214**, and then are passed to SGSN via GTP. Until this point, the processing of the packets is as done in a conventional GPRS system as in **Figure 1**. In the preferred embodiment, however, instead of just passing this information to BSS, **SGSN** will distribute packets received and forward non-data related packets to the PSTN gateway **213** via **Gs'ip** interface. The MG **213** converts these packets and sends information over T1 links to BSS. Similarly, signaling packets from **SGSN** are received over **Gs'ip** interface and get converted at Call Agent **212** and sent over the **'A'** interface. It should be noted that the conversion of data between the different type of subnetworks may be done by any current method, and is well within the ability of one of ordinary skill in the art.

Note that in both these cases, the vocoder is bypassed. Also, the Terminating Network **215** shown in **Figure 2** can be a Wireless Network, PSTN, or other compatible system.

In these figures, as in **Figure 1**, above, where Terminal Specific Signaling is indicated, the following designations apply:

| | | |
|---|---|---|
| H.323 | => | H.225 and Q.931 |
| SIP | => | SAP, SIP or RTSP |
| BSSx | => | Supports Voice and/or Circuit-Switched Data |
| BSSy | => | Supports Packet Data |

| | | |
|---|---|---|
| MSx | => | A Mobile Station which Supports Voice and/or Circuit-Switched Data |
| MSy | => | A Mobile Station which Supports Packet-Switched Data |

Further, solid lines are used to indicate a bearer traffic interface, dashed lines are used to indicate a signaling interface, and a dot/dash line is used to indicate a new bearer traffic and signaling interface according to the preferred embodiment.

**Figures 3-5** are exemplary illustrations of different transactions made over a system as shown in the preferred embodiment of **Figure 2**. **Figure 3** shows a diagram of the delivery of a telephone call or circuit-switched data transaction originating in an ANSI-136-A voice or circuit-switched data mobile station to an IP network or vice versa. Here,the call is routed as described above with relation to **Figure 2**, where the IP network **314**, instead of passing data to a terminating network (as **214** in **Figure 2**), simply routes the data via IP protocol to the remote IP end system **316** and/or to an H.323 terminal **317**.

**Figure 4** shows a diagram of the delivery of a telephone call or circuit-switched data transaction originating in an ANSI-136-A voice or circuit-switched data mobile station to another ANSI-136/ANSI-41 network (or vice versa) via an IP network. Here, the call is routed as described above with relation to **Figure 2**, where the terminating network is an ANSI-136/ANSI-41 network. After the call is routed to PSTN Gateway **423** from the GGSN of GPRS-136 network **406**, it is passed over an SS7 network **418**/PSTN **419** to the ANSI-136 mobile switching center **420**. From here, it is passed over the **A** interface and T1 to the BSSx **421**, and over the air to the ANSI -136 mobile station MSx **422**.

**Figure 5** shows a diagram of the delivery of a telephone call or circuit-switched data transaction originating in an ANSI-136-A voice or circuit-switched data mobile station to a Circuit-Switched Network (SCN) such as PSTN, ISDN via an IP network. Here, the call is routed as described above with relation to **Figure 2**, where the

terminating network is a PSTN. After the call is routed to PSTN Gateway **525** from the GGSN of the GPRS-136 network **506**, it is passed to the PSTN **519**, then to a standard POTS switch **523** and telephone **524**.

While the invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

Claims

1. A communications network, comprising:

a circuit-switched communications subnetwork;

a packet-switched subnetwork,

a Internet Protocol-based communications subnetwork, connected to send and receive data between the circuit-switched subnetwork and the packet-switched subnetwork; and

wherein the Internet Protocol-based subnetwork communicates both signal and bearer traffic for voice and data communications.

2. The network of claim 1, wherein the circuit-switched subnetwork includes an SS7 network.

3. The network of claim 1, wherein the packet-switched subnetwork includes a GPRS-136 network.

4. The network of claim 1, wherein the packet-switched subnetwork includes a GPRS-136HS network.

5. The network of claim 1, wherein the packet-switched subnetwork includes a EGPRS network.

6. The network of claim 1, further comprising a second Internet Protocol-based communications subnetwork connected to send and receive data from the packet-switched subnetwork.

7. The network of claim 1, further comprising a second circuit-switched subnetwork connected to send and receive data from the Internet Protocol-based subnetwork.

8. The network of claim 1, further comprising a public service telephone network connected to send and receive data from the packet-switched subnetwork.

9. The network of claim 1, wherein the circuit-switched subnetwork is configured to send and receive data from a wireless station.

10. The network of claim 1, wherein the circuit-switched subnetwork is configured to send and receive voice communications from a wireless station.

11. A method for communicating between electronic devices, comprising:

receiving a first data, from a mobile station, in a circuit-switched network;

converting the first data in to a second data, said second data being comprised of multiple data packets;

sending the second data over an Internet Protocol-based network;

receiving the second data in a packet-switched network; and

sending the second data to a terminating network.

12. The method of claim 11, wherein the circuit-switched subnetwork includes an SS7 network.

13. The method of claim 11, wherein the packet-switched subnetwork includes a GPRS-136 network.

14. The method of claim 11, wherein the packet-switched subnetwork includes a GPRS-136HS network.

15. The method of claim 11, wherein the packet-switched subnetwork includes a EGPRS network.

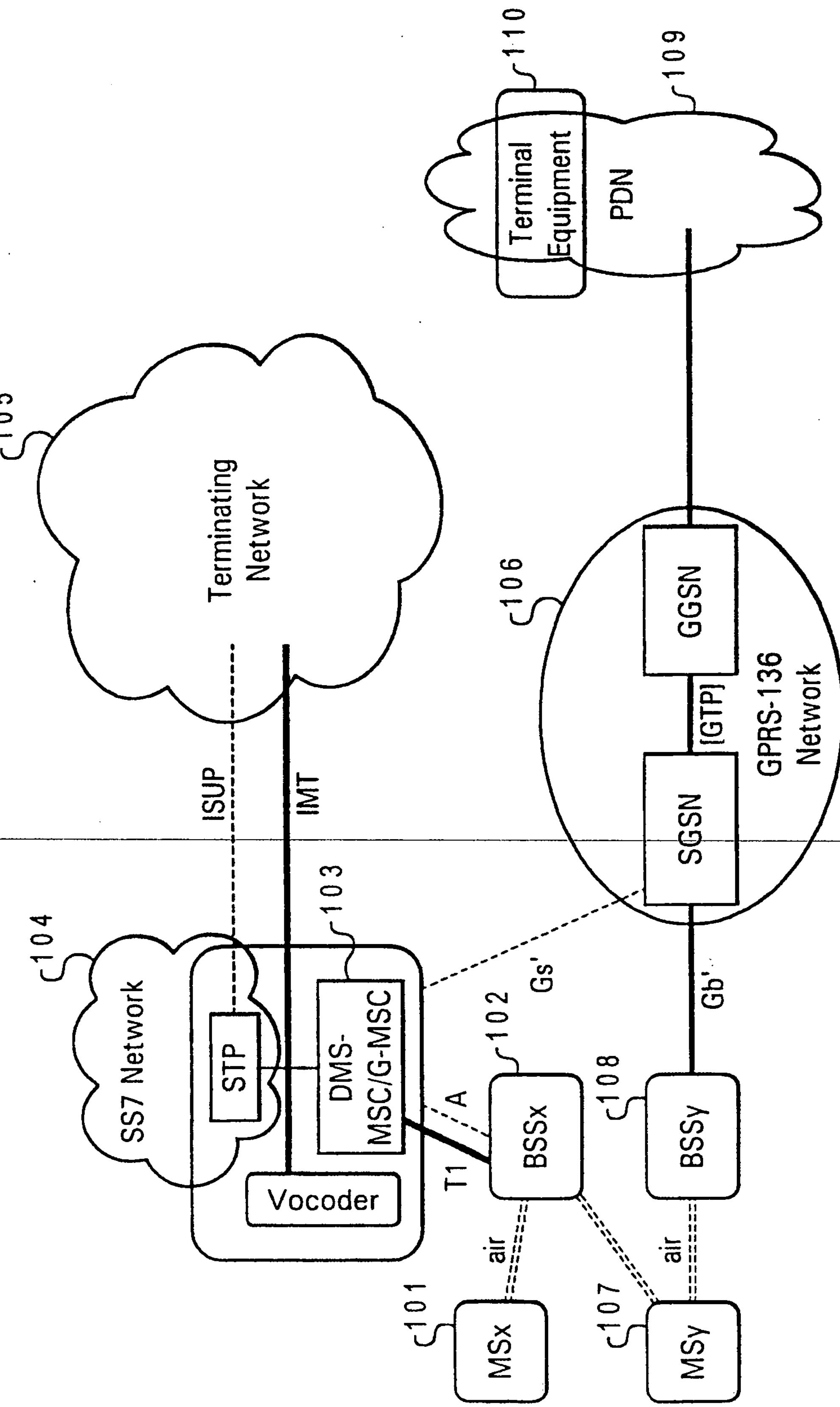
16. The method of claim 11, wherein the terminating network includes a second Internet Protocol-based communications subnetwork.

17. The method of claim 11, wherein the terminating network includes a second circuit-switched subnetwork.

18. The method of claim 11, wherein the terminating network includes a public service telephone network.

19. The method of claim 11, wherein the circuit-switched subnetwork communicates with the mobile station by wireless communications.

20. The method of claim 11, wherein the circuit-switched subnetwork is configured to send and receive voice communications from the mobile station.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109
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ISUP
IMT
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SS7 Network
STP
103
DMS-MSC/G-MSC
Vocoder
Gs'
Gb'
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T1
BSSx
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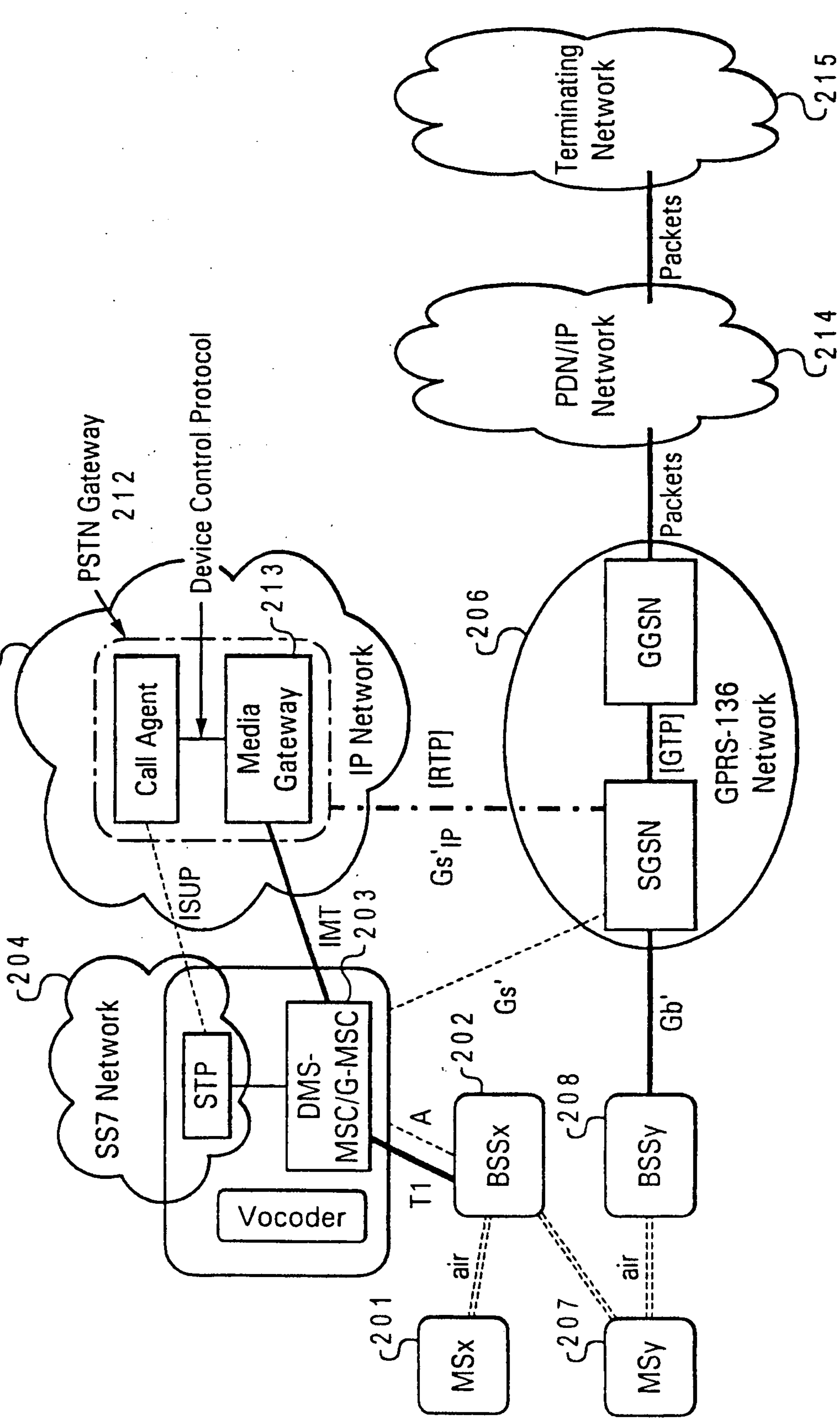
BSSy
air
air
101
MSx
107
MSy

*Fig. 1*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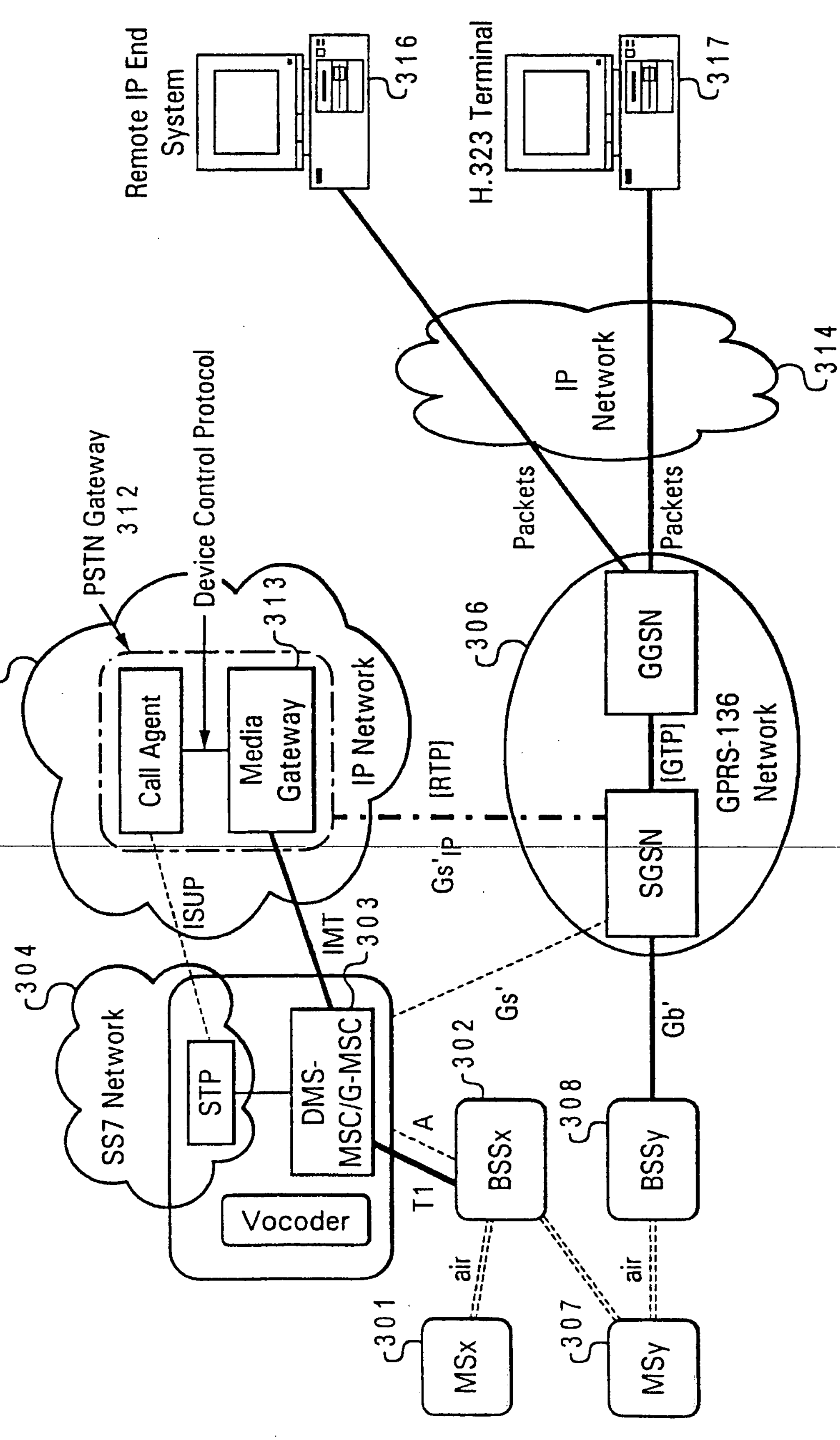
207
MSy

*Fig. 2*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IMT
303
304
SS7 Network
STP
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Vocoder
306
GGSN
[GTP]
SGSN
GPRS-136 Network
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Gb'
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BSSx
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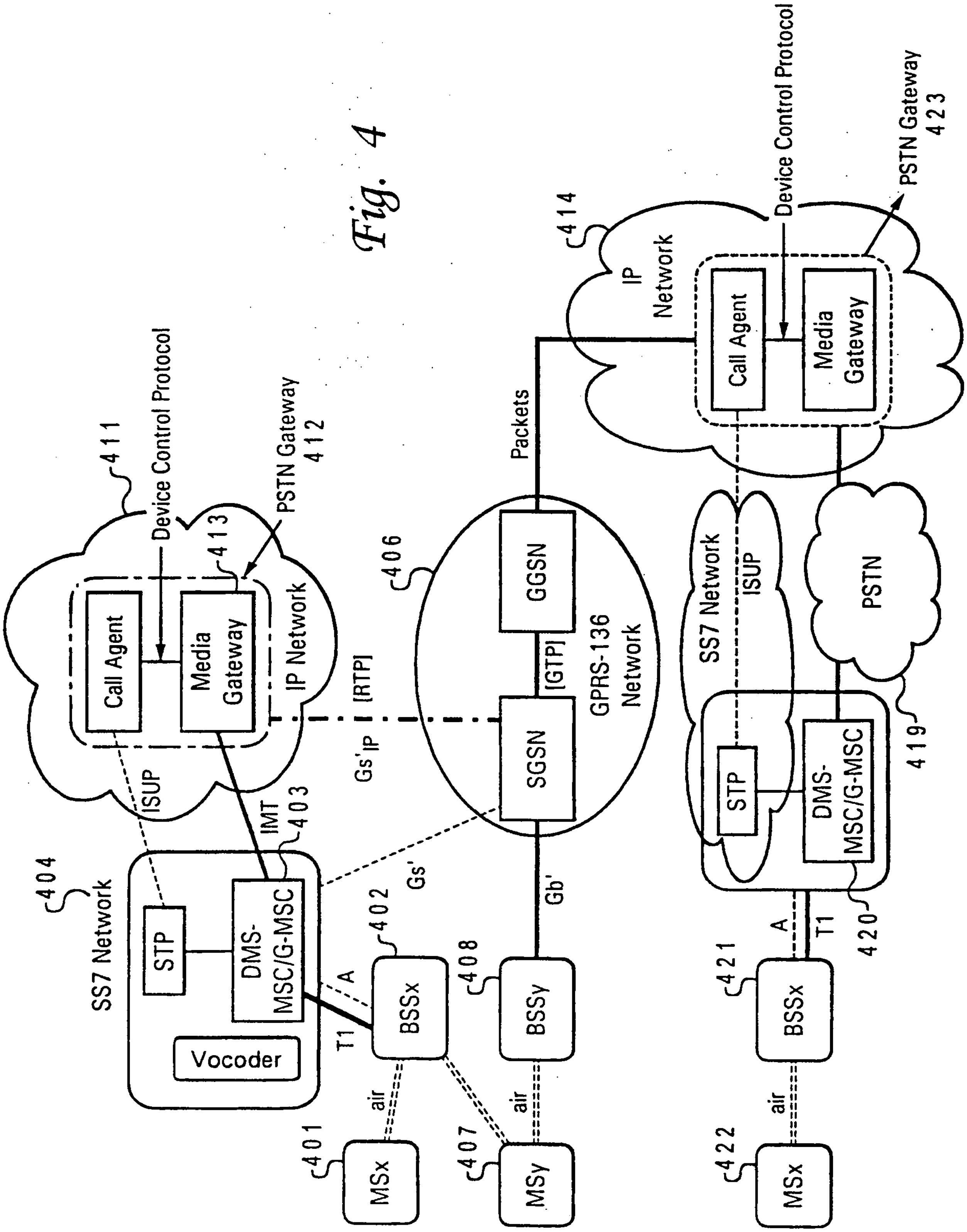
BSSy
air
air
301
MSx
307
MSy

*Fig. 3*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IMT
ISUP
Call Agent
Media Gateway
IP Network
Device Control Protocol
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402
BSSx
air
401
MSx
407
MSy
408
BSSy
Gs'
Gb'
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406
SGSN
GGSN
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Packets
414
IP Network
Call Agent
Media Gateway
Device Control Protocol
PSTN Gateway 423
SS7 Network
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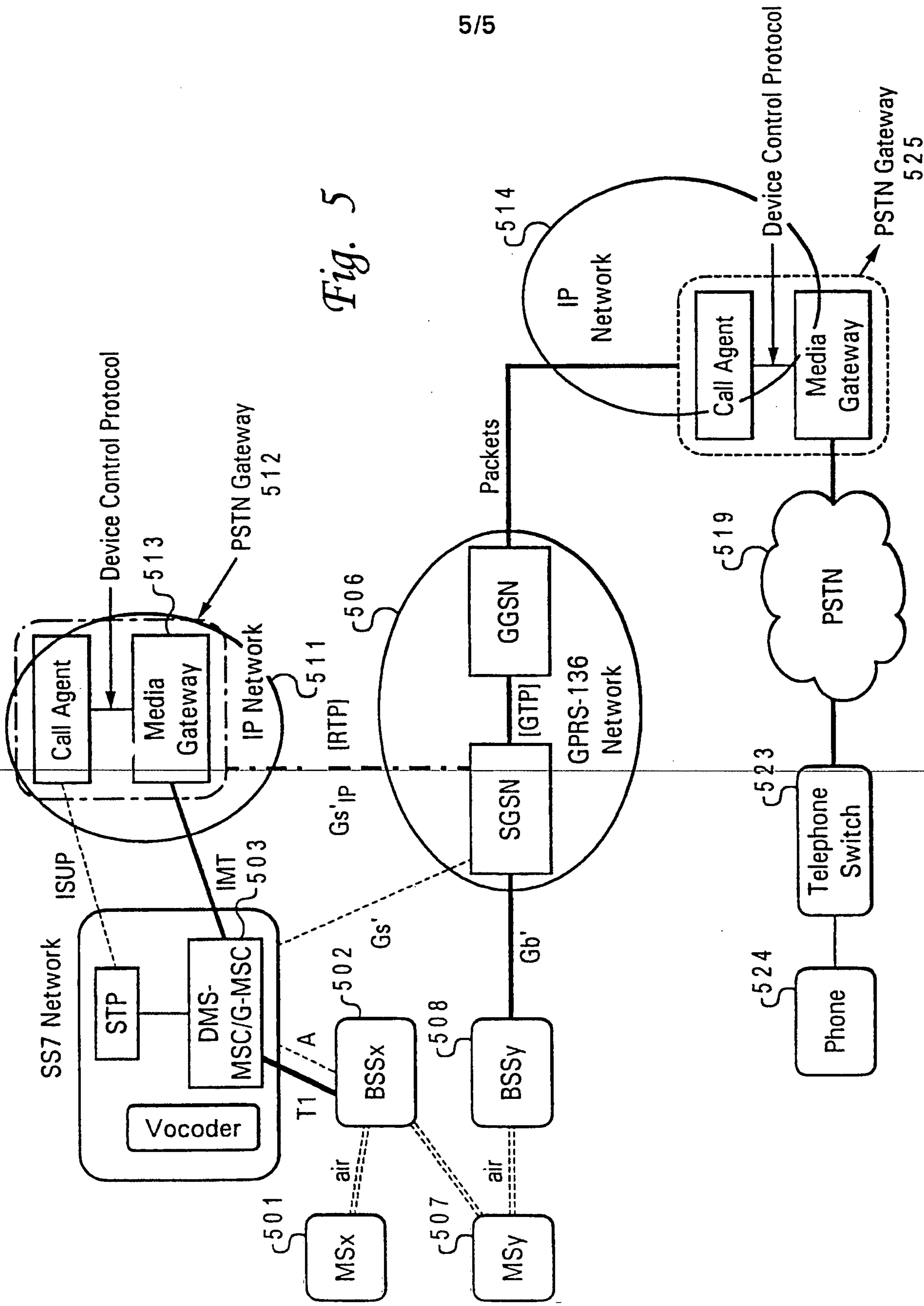
air
422
MSx

Fig. 4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BSSy
508
MSy
507
air
Gs'
Gb'
Call Agent
Media Gateway
IP Network
511
513
Device Control Protocol
PSTN Gateway 512
Gs'IP
[RTP]
SGSN
GGSN
[GTP]
GPRS-136 Network
506
Packets
IP Network
514
Call Agent
Media Gateway
Device Control Protocol
PSTN Gateway 525
PSTN
519
Telephone Switch
523
Phone
524

Fig. 5

# INTERNATIONAL SEARCH REPORT

Int nal Application No
PCT/US 99/27400

**A. CLASSIFICATION OF SUBJECT MATTER**
IPC 7 H04L12/56 H04L12/28 H04M7/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04M H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
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